

SECTION 23
MECHANICAL

COMMON WORK RESULTS FOR HVAC

Part 1 General

1.1 SUBMITTALS

- .1 Submittals: in accordance with CW 1110.
- .2 Shop drawings; submit drawings stamped and signed by professional engineer registered or licensed in Province of Manitoba, Canada.
- .3 Shop drawings to show:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances.
- .4 Shop drawings and product data accompanied by:
 - .1 Detailed drawings of bases, supports, and anchor bolts.
 - .2 Acoustical sound power data, where applicable.
 - .3 Points of operation on performance curves.
 - .4 Manufacturer to certify current model production.
 - .5 Certification of compliance to applicable codes.
- .5 Closeout Submittals:
 - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
 - .2 Operation and maintenance manual approved by, and final copies deposited with, Contract Administrator before final inspection.
 - .3 Operation data to include:
 - .1 Control schematics for systems including environmental controls.
 - .2 Description of systems and their controls.
 - .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
 - .4 Operation instruction for systems and component.
 - .5 Description of actions to be taken in event of equipment failure.
 - .6 Valves schedule and flow diagram.
 - .7 Colour coding chart.
 - .4 Maintenance data to include:
 - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
 - .2 Data to include schedules of tasks, frequency, tools required and task time.
 - .5 Performance data to include:
 - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.

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- .2 Equipment performance verification test results.
- .3 Special performance data as specified.
- .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .6 Approvals:
 - .1 Submit 1 copies of draft Operation and Maintenance Manual to Contract Administrator for approval. Submission of individual data will not be accepted unless directed by Contract Administrator.
 - .2 Make changes as required and re-submit as directed by Contract Administrator.
- .7 Additional data:
 - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .8 Site records:
 - .1 Contract Administrator will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur.
 - .2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.
 - .3 Use different colour waterproof ink for each service.
 - .4 Make available for reference purposes and inspection.
- .9 As-built drawings:
 - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
 - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
 - .3 Submit to Contract Administrator for approval and make corrections as directed.
 - .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
 - .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .10 Submit copies of as-built drawings for inclusion in final TAB report.

1.2 MAINTENANCE

- .1 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

COMMON WORK RESULTS FOR HVAC

Part 2 Products (Not Used)

Part 3 Execution

3.1 PAINTING REPAIRS AND RESTORATION

- .1 Prime and touch up marred finished paintwork to match original.
- .2 Restore to new condition, finishes which have been damaged.

3.2 CLEANING

- .1 Clean interior and exterior of all systems. Vacuum interior of ductwork and air handling units.

3.3 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.4 DEMONSTRATION

- .1 Contract Administrator will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .3 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.
- .4 Instruction duration time requirements as specified in appropriate sections.
- .5 Contract Administrator will record these demonstrations on video tape for future reference.

3.5 PROTECTION

- .1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

END OF SECTION

USE OF HVAC SYSTEMS DURING CONSTRUCTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

- .1 Use of mechanical systems during construction.

1.2 USE OF SYSTEMS

.1 Use of new and/or existing permanent heating and ventilating systems for supplying temporary heat or ventilation is permitted only under following conditions:

- .1 Entire system is complete, pressure tested, cleaned, flushed out.
 - .2 Building has been closed in, areas to be heated/ventilated are clean and will not thereafter be subjected to dust-producing processes.
 - .3 There is no possibility of damage.
 - .4 Supply ventilation systems are protected by 60% filters, inspected daily, changed every week or more frequently as required.
 - .5 Return systems have approved filters over openings, inlets, outlets.
 - .6 Systems will be:
 - .1 Operated as per manufacturer's recommendations and instructions.
 - .2 Operated by Contractor.
 - .3 Monitored continuously by Contractor.
 - .7 Warranties and guarantees are not relaxed.
 - .8 Regular preventive and other manufacturers recommended maintenance routines are performed by Contractor at own expense and under supervision of Contract Administrator.
 - .9 Refurbish entire system before static completion; clean internally and externally, restore to "as- new" condition, replace filters in air systems.
- .2 Filters specified in this Section are over and above those specified in other Sections of this project.
- .3 Exhaust systems are not included in approvals for temporary heating ventilation.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

MECHANICAL IDENTIFICATION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials and requirements for the identification of piping systems, duct work, valves and controllers, including the installation and location of identification systems.
 - .2 Sustainable requirements for construction and verification.

1.2 REFERENCES

- .1 Canadian Gas Association (CGA)
 - .1 CSA/CGA B149.1-05, Natural Gas and Propane Installation Code.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.60-97, Interior Alkyd Gloss Enamel.
 - .2 CAN/CGSB-24.3-92, Identification of Piping Systems.
- .3 National Fire Protection Association (NFPA)
 - .1 NFPA 13-2002, Standard for the Installation of Sprinkler Systems.
 - .2 NFPA 14-2003, Standard for the Installation of Standpipe and Hose Systems.

1.3 SUBMITTALS

- .1 Product Data:
- .2 Submittals: in accordance with CW 1110.
- .3 Product data to include paint colour chips, other products specified in this section.

Part 2 Products

2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES

- .1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.
- .2 Lettering and numbers raised or recessed.
- .3 Information to include, as appropriate:
 - .1 Equipment: manufacturer's name, model, size, serial number, capacity.
 - .2 Motor: voltage, Hz, phase, power factor, duty, frame size.

MECHANICAL IDENTIFICATION

2.2 SYSTEM NAMEPLATES

- .1 Colours:
 - .1 Hazardous: red letters, white background.
 - .2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).
- .2 Construction:
 - .1 3 mm thick laminated plastic, matte finish, with square corners, letters accurately aligned and machine engraved into core.
- .3 Sizes:
 - .1 Conform to following table:

Size #	Sizes (mm)	No. of Lines	Height of Letters (mm)
1	10 x 50	1	3
2	13 x 75	1	5
3	13 x 75	2	3
4	20 x 100	1	8
5	20 x 100	2	5
6	20 x 200	1	8
7	25 x 125	1	12
8	25 x 125	2	8
9	35 x 200	1	20
 - .2 Use maximum of 25 letters/numbers per line.
- .4 Locations:
 - .1 Terminal cabinets, control panels: use size # 5.
 - .2 Equipment in Mechanical Rooms: use size # 9.

2.3 EXISTING IDENTIFICATION SYSTEMS

- .1 Apply existing identification system to new work.
- .2 Where existing identification system does not cover for new work, use identification system specified this section.
- .3 Before starting work, obtain written approval of identification system from Contract Administrator.

2.4 IDENTIFICATION DUCTWORK SYSTEMS

- .1 50 mm high stencilled letters and directional arrows 150 mm long x 50 mm high.
- .2 Colours: back, or co-ordinated with base colour to ensure strong contrast.

MECHANICAL IDENTIFICATION

2.5 CONTROLS COMPONENTS IDENTIFICATION

- .1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section.
- .2 Inscriptions to include function and (where appropriate) fail-safe position.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 NAMEPLATES

- .1 Locations:
 - .1 In conspicuous location to facilitate easy reading and identification from operating floor.
- .2 Standoffs:
 - .1 Provide for nameplates on hot and/or insulated surfaces.
- .3 Protection:
 - .1 Do not paint, insulate or cover.

3.3 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS

- .1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: at not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.
- .2 Adjacent to each change in direction.
- .3 At least once in each small room through which piping or ductwork passes.
- .4 On both sides of visual obstruction or where run is difficult to follow.
- .5 On both sides of separations such as walls, floors, partitions.
- .6 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.
- .7 At beginning and end points of each run and at each piece of equipment in run.
- .8 At point immediately upstream of major manually operated or automatically controlled valves, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.

MECHANICAL IDENTIFICATION

- .9 Identification easily and accurately readable from usual operating areas and from access points.
 - .1 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

END OF SECTION

THERMAL INSULATION FOR DUCTING

Part 1 General

1.1 REFERENCES

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - .1 ANSI/ASHRAE/IESNA 90.1-01, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM B209M-02, Specification for Aluminum and Aluminum Alloy Sheet and Plate (Metric).
 - .2 ASTM C335-95, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
 - .3 ASTM C411-97, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .4 ASTM C449/C449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .5 ASTM C547-00, Specification for Mineral Fiber Pipe Insulation.
 - .6 ASTM C553-00, Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - .7 ASTM C612-00a, Specification for Mineral Fiber Block and Board Thermal Insulation.
 - .8 ASTM C795-92, Specification for Thermal Insulation for Use with Austenitic Stainless Steel.
 - .9 ASTM C921-92(1998)e1, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
- .3 Canadian General Standards Board (CGSB)
 - .1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .4 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (R1999).
- .5 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-M88(R2000), Surface Burning Characteristics of Building Materials and Assemblies.
 - .2 CAN/ULC-S701-01, Thermal Insulation Polyotrene, Boards and Pipe Covering.

1.2 DEFINITIONS

- .1 For purposes of this section:
 - .1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.
 - .2 "EXPOSED" - will mean "not concealed" as defined herein.
 - .3 Insulation systems - insulation material, fasteners, jackets, and other accessories.

THERMAL INSULATION FOR DUCTING

- .2 TIAC Codes:
 - .1 CRD: Code Round Ductwork,
 - .2 CRF: Code Rectangular Finish.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with CW 1110.
- .2 Submit for approval manufacturer's catalogue literature related to installation, fabrication for duct jointing recommendations.

1.4 MANUFACTURERS' INSTRUCTIONS

- .1 Submit manufacturer's installation instructions in accordance with CW 1110.
- .2 Installation instructions to include procedures used, and installation standards achieved.

1.5 QUALIFICATIONS

- .1 Installer: specialist in performing work of this section, and have at least 3 years successful experience in this size and type of project, qualified to standards.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .2 Protect from weather and construction traffic.
- .3 Protect against damage from any source.
- .4 Store at temperatures and conditions recommended by manufacturer.

Part 2 Products

2.1 FIRE AND SMOKE RATING

- .1 In accordance with CAN/ULC-S102:
 - .1 Maximum flame spread rating: 25.
 - .2 Maximum smoke developed rating: 50.

2.2 INSULATION

- .1 Mineral fibre: as specified includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C335.
- .3 TIAC Code C-1: Rigid mineral fibre board to ASTM C612, with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this Section).

THERMAL INSULATION FOR DUCTING

- .4 TIAC Code C-2: Mineral fibre blanket to ASTM C553 faced with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this section).
 - .1 Mineral fibre: to ASTM C553.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: to ASTM C553.

2.3 JACKETS

- .1 Aluminum:
 - .1 To ASTM B209 with moisture barrier as scheduled in PART 3 of this section.
 - .2 Thickness: 0.50 mm sheet.
 - .3 Finish: Stucco embossed.
 - .4 Jacket banding and mechanical seals: 12 mm wide, 0.5 mm thick stainless steel.

2.4 ACCESSORIES

- .1 Vapour retarder lap adhesive:
 - .1 Water based, fire retardant type, compatible with insulation.
- .2 Indoor Vapour Retarder Finish:
 - .1 Vinyl emulsion type acrylic, compatible with insulation.
- .3 Insulating Cement: hydraulic setting on mineral wool, to ASTM C449.
- .4 ULC Listed Canvas Jacket:
 - .1 220 gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
- .5 Outdoor Vapour Retarder Mastic:
 - .1 Vinyl emulsion type acrylic, compatible with insulation.
 - .2 Reinforcing fabric: Fibrous glass, untreated 305 g/m².
- .6 Tape: self-adhesive, aluminium, reinforced, 75 mm wide minimum.
- .7 Contact adhesive: quick-setting
- .8 Canvas adhesive: washable.
- .9 Tie wire: 1.5 mm stainless steel.
- .10 Banding: 12 mm wide, 0.5 mm thick stainless steel.
- .11 Fasteners: 4 mm diameter pins with 35 mm diameter clips, length to suit thickness of insulation.

THERMAL INSULATION FOR DUCTING

Part 3 Execution

3.1 PRE-INSTALLATION REQUIREMENTS

- .1 Pressure testing of ductwork systems complete, witnessed and certified.
- .2 Surfaces clean, dry, free from foreign material.

3.2 INSTALLATION

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturers instructions and as indicated.
- .3 Use two layers with staggered joints when required nominal thickness exceeds 75 mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Hangers, supports to be outside vapour retarder jacket.
- .5 Supports, Hangers in accordance with Section 23 31 14 - Metal Ducts - Low Pressure To 500 Pa.
 - .1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.
- .6 Fasteners: At 300 mm oc in horizontal and vertical directions, minimum two rows each side.

3.3 DUCTWORK INSULATION SCHEDULE

- .1 Insulation types and thicknesses: Conform to following table:

	<u>TIAC Code</u>	<u>Vapour Retarder</u>	<u>Thickness (mm)</u>
Rectangular cold and dual temperature supply air ducts	C-1	yes	25
Round cold and dual temperature supply air ducts	C-2	yes	25
Exhaust duct between fan and louvers	C-1	No	50

END OF SECTION

METAL DUCTS - LOW PRESSURE TO 500 PA

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials and installation of low-pressure metallic ductwork, joints and accessories.

1.2 REFERENCES

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
- .2 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM A480/A480M-03c, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
 - .2 ASTM A635/A635M-02, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot Rolled.
 - .3 ASTM A653/A653M-03, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- .3 Department of Justice Canada (Jus).
 - .1 Canadian Environmental Protection Act (CEPA), 1999, c. 33 .
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
- .5 National Fire Protection Association (NFPA).
 - .1 NFPA 90A-02, Standard for the Installation of Air-Conditioning and Ventilating Systems.
 - .2 NFPA 90B-02, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
 - .3 NFPA 96-01, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .6 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
 - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2nd Edition 1995 and Addendum No. 1, 1997.
 - .2 SMACNA HVAC Air Duct Leakage Test Manual, 1985, 1st Edition.
 - .3 IAQ Guideline for Occupied Buildings Under Construction 1995, 1st Edition.
- .7 Transport Canada (TC).
 - .1 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

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1.3 QUALITY ASSURANCE

- .1 Certification of Ratings:
 - .1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

Part 2 Products

2.1 SEAL CLASSIFICATION

- .1 Classification as follows:

<u>Maximum Pressure Pa</u>	<u>SMACNA Seal Class</u>
500	C
250	C
125	C

- .2 Seal classification:
 - .1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.
 - .2 Class B: longitudinal seams, transverse joints and connections made airtight with sealant.
 - .3 Class C: transverse joints and connections made air tight with gaskets, sealant or combination thereof. Longitudinal seams unsealed.

2.2 SEALANT

- .1 Sealant: oil resistant, polymer type flame resistant duct sealant. Temperature range of minus 30 degrees C to plus 93 degrees C.

2.3 DUCT LEAKAGE

- .1 In accordance with SMACNA HVAC Air Duct Leakage Test Manual.

2.4 FITTINGS

- .1 Fabrication: to SMACNA.
- .2 Radiused elbows.
 - .1 Rectangular: standard radius or short radius with single thickness turning vanes. Centreline radius: 1.5 times width of duct.
 - .2 Round: smooth radius. Centreline radius: 1.5 times diameter.
- .3 Mitred elbows, rectangular:
 - .1 To 400 mm: with single thickness turning vanes.
 - .2 Over 400 mm: with double thickness turning vanes.

METAL DUCTS - LOW PRESSURE TO 500 PA

- .4 Branches:
 - .1 Rectangular main and branch: with radius on branch 1.5 times width of duct or 45 degrees entry on branch.
 - .2 Round main and branch: enter main duct at 45 degrees with conical connection.
 - .3 Provide volume control damper in branch duct near connection to main duct.
 - .4 Main duct branches: with splitter damper.
- .5 Transitions:
 - .1 Diverging: 20 degrees maximum included angle.
 - .2 Converging: 30 degrees maximum included angle.
- .6 Offsets:
 - .1 as indicated.
- .7 Obstruction deflectors: maintain full cross-sectional area.
 - .1 Maximum included angles: as for transitions.

2.5 GALVANIZED STEEL

- .1 Lock forming quality: to ASTM A653/A653M, Z90 zinc coating.
- .2 Thickness, fabrication and reinforcement: to SMACNA.
- .3 Joints: to SMACNA.

2.6 STAINLESS STEEL

- .1 To ASTM A480/A480M, Type 304.
- .2 Finish: No. 4.
- .3 Thickness, fabrication and reinforcement: to SMACNA.
- .4 Joints: to SMACNA.

2.7 HANGERS AND SUPPORTS

- .1 Hangers and Supports:
 - .1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct.
 - .1 Maximum size duct supported by strap hanger: 500.
 - .2 Hanger configuration: to ASHRAE and SMACNA.
 - .3 Hangers: galvanized steel angle with galvanized steel rods to following table:

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)
up to 750	25 x 25 x 3	6
751 to 1050	40 x 40 x 3	6

METAL DUCTS - LOW PRESSURE TO 500 PA

Duct Size	Angle Size	Rod Size
1051 to 1500	40 x 40 x 3	10
1501 to 2100	50 x 50 x 3	10
2101 to 2400	50 x 50 x 5	10
2401 and over	50 x 50 x 6	10

- .4 Upper hanger attachments:
 - .1 For concrete: manufactured concrete inserts.
 - .2 For steel joist: manufactured joist clamp.
 - .3 For steel beams: manufactured beam clamps:

Part 3 Execution

3.1 GENERAL

- .1 Do work in accordance with SMACNA as indicated.
- .2 Do not break continuity of insulation vapour barrier with hangers or rods.
 - .1 Ensure diffuser is fully seated.
- .3 Support risers in accordance with SMACNA.
- .4 Install breakaway joints in ductwork on sides of fire separation.
- .5 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.

3.2 HANGERS

- .1 Strap hangers: install in accordance with SMACNA.
- .2 Angle hangers: complete with locking nuts and washers.
- .3 Hanger spacing: in accordance with SMACNA:

3.3 WATERTIGHT DUCT

- .1 Fit base of riser with 150 mm deep drain sump and 32 mm drain connected, with deep seal trap and discharging to open funnel drain or as indicated.

3.4 SEALING AND TAPING

- .1 Apply sealant to outside of joint to manufacturer's recommendations.

3.5 LEAKAGE TESTS

- .1 In accordance with SMACNA HVAC Duct Leakage Test Manual.
- .2 Do leakage tests in sections.

METAL DUCTS - LOW PRESSURE TO 500 PA

- .3 Make trial leakage tests as instructed to demonstrate workmanship.
- .4 Do not install additional ductwork until trial test has been passed.
- .5 Complete test before performance insulation or concealment Work.

END OF SECTION

HVAC FANS

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Fans, motors, accessories and hardware.

1.2 REFERENCES

- .1 Air Conditioning and Mechanical Contractors (AMCA)
 - .1 AMCA Publication 99-2003, Standards Handbook.
 - .2 AMCA 300-1996, Reverberant Room Method for Sound Testing of Fans.
 - .3 AMCA 301-1990, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- .2 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)
 - .1 ANSI/AMCA 210-1999, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
- .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB 1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.3 SYSTEM DESCRIPTION

- .1 Performance Requirements:
 - .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards in force.
 - .2 Capacity: flow rate, static pressure, bhp, efficiency, revolutions per minute, power, model, size, sound power data and as indicated on schedule.
 - .3 Fans: statically and dynamically balanced, constructed in conformity with AMCA 99.
 - .4 Sound ratings: comply with AMCA 301, tested to AMCA 300. Supply unit with AMCA certified sound rating seal.
 - .5 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210. Supply unit with AMCA certified rating seal.

1.4 SUBMITTALS

- .1 Product Data:

HVAC FANS

- .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with CW 1110. Include product characteristics, performance criteria, and limitations.
- .2 Shop Drawings:
 - .1 Submit shop drawings and product data in accordance with CW 1110.
- .3 Provide :
 - .1 Fan performance curves showing point of operation, BHP and efficiency.
 - .2 Sound rating data at point of operation.
- .4 Indicate:
 - .1 Motors, sheaves, bearings, shaft details.
- .5 Quality assurance submittals: submit following in accordance with CW 1110.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.

1.5 MAINTENANCE

- .1 Extra Materials:
 - .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
 - .1 Spare parts to include:
 - .1 Matched sets of belts.
 - .2 Furnish list of individual manufacturer's recommended spare parts for equipment, include:
 - .1 Bearings and seals.
 - .2 Addresses of suppliers.
 - .3 List of specialized tools necessary for adjusting, repairing or replacing.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

Part 2 Products

HVAC FANS

2.1 EXHAUST FANS (EF-1, EF-2, EF-3)

- .1 Each exhaust fan shall suitable for installation in a sewage treatment plant and shall be rated for 1180 L/s @ 250 Pa (2500 CFM @ 1" ESP), 1986 FRPM, 2.31 BHP, 575V / 3PH / 60Hz, 3 HP, TEFC motor, belt drive, continuously welded housing, inlet collar, flanged outlet, heavy duty self-aligning ball or roller pillow block bearings, polished solid steel shafts, fully welded heavy gauge wheel, statically and dynamically balanced, belt guard, factory mounted base with vibration isolators, industrial epoxy coating – entire unit. CSA Approved.
- .2 Acceptable Product: "Greenheck" Model: 9-IPA

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 FAN INSTALLATION

- .1 Install fans as indicated, complete with flexible electrical leads and flexible connections.
- .2 Provide sheaves and belts required for final air balance.
- .3 Bearings and extension tubes to be easily accessible.
- .4 Access doors and access panels to be easily accessible.

3.3 CLEANING

- .1 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

HIGH DENSITY SCRUBBER

Part 1 General

1.1 SUMMARY

.1 Section Includes:

- .1 Filters and filter gauges for various types of mechanical air handling equipment.

1.2 REFERENCES

- .1 American National Standards Institute/National Fire Prevention Association (ANSI/NFPA)ANSI/NFPA 96-04, Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .2 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
 - .1 ASHRAE 52.1-1992, Gravimetric And Dust Spot for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter (ANSI Approved).
- .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-115.10-M90, Disposable Air Filters for the Removal of Particulate Matter from Ventilating Systems.
 - .2 CAN/CGSB-115.11-M85, Filters, Air, High Efficiency, Disposable, Bag Type.
 - .3 CAN/CGSB-115.12-M85, Filters, Air, Medium Efficiency, Disposable, Bag Type.
 - .4 CAN/CGSB-115.13-85, Filter Media, Automatic Roll.
 - .5 CAN/CGSB-115.14-M91, High Efficiency Cartridge Type Supported Air Filters for the Removal of Particulate Matter from Ventilating Systems.
 - .6 CAN/CGSB-115.15-M91, High Efficiency Rigid Type Air Filters for Removal of Particulate Matter from Ventilating Systems.
 - .7 CAN/CGSB-115.16-M82, Activated Carbon for Odor Removal from Ventilating Systems.
 - .8 CAN/CGSB-115.18-M85, Filter, Air, Extended Area Panel Type, Medium Efficiency.
 - .9 CAN/CGSB-115.20-95, Polarized Media Air Filter.
- .4 Underwriters' Laboratories of CanadaULC -S111-95, Standard Method of Fire Tests for Air Filter Units.
 - .1 ULC-S649-1993, Exhaust Hoods and Related Controls for Commercial and Institutional Kitchens.

1.3 SUBMITTALS

.1 Product Data:

- .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with CW 1110. Include product characteristics, performance criteria, and limitations.

HIGH DENSITY SCRUBBER

- .2 Shop Drawings:
 - .1 Submit shop drawings in accordance with CW 1110.
- .3 Quality assurance submittals: submit following in accordance with CW 1110.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

1.5 MAINTENANCE

- .1 Extra Materials:
 - .1 Furnish list of individual manufacturer's recommended spare parts for equipment such as frames and filters, addresses of suppliers, list of specialized tools necessary for adjusting, repairing or replacing for inclusion in operating manual.
 - .2 Spare filters: in addition to filters installed immediately prior to acceptance by Contract Administrator, supply 3 complete sets of filters for each filter unit.

Part 2 Products

2.1 HIGH DENSITY SCRUBBER (HDS-1)

- .1 General
 - .1 The scrubber shall be suitable for providing clean air to pressurize an MCC room in a sewage treatment plant. The environment where the air is drawing from shall be considered moderate (Classification G-2) with concentration of H₂S less than 10 ppb. The scrubber shall be designed in a counter-flow configuration, for gravity media loading and unloading, and shall be supplied with an adjacent media loading platform. The discharge orientation shall be as indicated on the drawings c/w manual damper and with a flanged connection. Unit shall be designed/built with capability for future media upgrade. All particulate filters supplied shall be as per ASHRAE Standard 52 for their indicated efficiencies, and shall be shipped within the HDS unit.
- .2 Construction
 - .1 The main hopper section shall be manufactured of Fiberglass Reinforced Plastic (FRP), with the exception of the media test port and media discharge port, each fabricated of PVC. The hopper supporting structure and ladder shall be fabricated of

HIGH DENSITY SCRUBBER

structural steel, c/w aluminum non-skid safety tread for media loading, and media testprobe shipped loose. Intake and discharge sections shall be of extruded aluminum Penta-Post frame design, non-access panels shall be bolted and sealed, access panels shall be c/w stainless steel hinges and finger operable locking devices. Units shall be coated with a corrosion resistant polyurethane enamel. All unit intake and discharge sections shall contain a one inch flanged ductwork connection.

.3 Intake Section

- .1 Intake section contain a 20% aluminum mesh roughing filters.

.4 Fan Section

- .1 The HDS unit shall contain a standard FRP blower, c/w flexible connections to the intake and hopper sections, designed in an AMCA arrangement 10 configuration. Blower shall be statically and dynamically balanced, c/w a belt/bearing guard and drain plug, mounted on rubber vibration isolators, c/w adjustable drives and link belts rated at 150% of the designed motor horse power. Fan shall be designed at 188L/s (400 CFM) with 250 Pa (1" W.C.) static pressure external to the HDS unit (all losses internal to the HDS unit shall be added to the external static pressure of 250 Pa when sizing the fan by the manufacturer). Motor shall be TEFC, 3HP, 575/3/60, 3600 RPM.

.5 Chemical Media Section

- .1 Hopper shall contain 0.28 m³ (10 cu.ft.) of chemical media type MM-9000, providing a residence time of 1.5 seconds. Total media weight shall be 158 kgs.

.6 Standard Discharge Section

- .1 HDS shall contain a discharge section mounted downstream of the hopper, fabricated as indicated above, c/w a 40% roughing filter and a 95% final filter.

.7 Differential Pressure Monitoring System

- .1 The unit shall be c/w four magnehelic gauges, factory mounted and tubed to monitor pressure drop across all particulate filters and chemical media bed.

.8 Control Panel

- .1 The HDS shall be supplied with a combination starter, mounted on the structure directly beside the motor, and wired to the motor. Combination starter shall be c/w a fused disconnect, three position (Hand/Off/Auto) selector switch, and on/off indicator lights. Starter shall be NEMA 4X rated for the specified motor.
- .2 Provide factory mounted and wired Air Proving Switch to alarm fan failure. An alarm shall be generated if there is no airflow when the motor is energized. A fan failure indicator light c/w dry contact for remote alarming shall be provided in the control panel.

- .9 Acceptable Product: "Circul Aire" Model: HDS 4C c/w all options as specified above.

HIGH DENSITY SCRUBBER

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION GENERAL

- .1 Install in accordance with manufacturer's recommendations and with adequate space for access, maintenance and replacement.

3.3 ACTIVATED CARBON TYPE FILTERS

- .1 During testing, adjusting and balancing, install substitute media.

3.4 REPLACEMENT MEDIA

- .1 Replace media with new upon acceptance.
- .2 Filter media new and clean, as indicated by pressure gauge, at time of acceptance.

3.5 FILTER GAUGES

- .1 Install type as indicated across each filter bank (pre-filter and final filter) in approved and easy readable location.
- .2 Mark each filter gauge with value of pressure drop for clean condition and manufacturer's recommended replacement (dirty) value.

3.6 CLEANING

- .1 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

AIR HANDLING UNITS – PACKAGED

Part 1 General

1.1 SUMMARY

- .1 Supply, install, and commission roof top air conditioning unit as specified herein

1.2 REFERENCES

- .1 American National Standards Institute/Air-Conditioning and Refrigeration Institute (ANSI/ARI)
 - .1 ANSI/ARI 430-99, Central Station Air Handling Units.
 - .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB 1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with CWSCS.
- .2 Indicate following: fan, motor drive, voltage, dimensions, total cooling, sensible cooling,; include performance data.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 EXTRA MATERIALS

- .1 Provide list of individual manufacturer's recommended spare parts for equipment such as bearings and seals, and addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.
- .2 Spare filters: in addition to filters installed immediately prior to acceptance by Contract Administrator, supply 5 complete sets of filters for each filter unit or filter bank.

Part 2 Products

2.1 ROOF TOP AIR CONDITIONING UNIT (RTU-1)

- .1 General:
 - .1 Factory assembled, single-piece cooling unit. Contained within the unit enclosure shall be all factory wiring, piping, controls, and refrigerant charge (R-22) and special features required prior to field start-up. The unit shall have a 4 ton capacity and shall be rated for 755 L/s @ 75 Pa (1600 CFM @ 0.3" E.S.P).
- .2 Unit Cabinet:

AIR HANDLING UNITS – PACKAGED

- .1 Unit cabinet shall be constructed of galvanized steel construction, and shall be bonderized and coated with prepainted baked enamel finish on all externally exposed surfaces.
- .2 Evaporator fan compartment interior cabinet surfaces shall be insulated with a minimum 13mm thick, flexible fibreglass insulation, neoprene coated on the air side.
- .3 Cabinet panels shall be removable for servicing.
- .4 Unit shall have a factory-installed, sloped condensate drain pan made of a non-corrosive material, providing a minimum 19mm (3/4"NPT) connection.
- .5 Unit shall have a factory-installed filter access panel.
- .3 Fans:
 - .1 Evaporator Fan:
 - .1 Fan shall be belt driven, c/w adjustable-pitch motor pulley.
 - .2 Fan wheel shall be double-inlet type with forward-curved blades.
 - .3 Bearing shall be sealed, permanently lubricated ball bearing type.
 - .4 Fan shall be made from steel with corrosion-resistant finish, statically and dynamically balanced.
 - .2 Condenser fan shall be direct driven, totally enclosed motors, propeller type, and shall discharge air vertically. Condenser fan shall have aluminum blades riveted to corrosion-resistant steel spiders, and shall be dynamically balanced.
- .4 Compressor shall be:
 - .1 Fully hermetic, internally protected scroll-type.
 - .2 Factory mounted on rubber grommets, internally spring mounted for vibration isolation.
- .5 Coils:
 - .1 Evaporator and Condenser Coils shall have aluminum lanced plate fins mechanically bonded to seamless internally grooved copper tubes, brazed joints.
 - .2 Testing:
 - .1 Qualified to UL 1995 burst test at 2200 PSI.
 - .2 Leak tested to 150 PSIG, pressure test to 400 PSIG.
- .6 Refrigerant Components shall include:
 - .1 Fixed orifice metering system.
 - .2 Refrigerant filter drier.
 - .3 Service gage connections on suction, discharge, and liquid lines.
- .7 Filter Section:
 - .1 Factory-installed, low velocity, throwaway 50mm (2") thick fibreglass filters, commercially available sizes, use one size filter.
 - .2 Filter face velocity shall not exceed 1.6 m/s (320 FPM) at nominal airflows.
 - .3 Filters shall be accessible through access panel with "no-tool" removal.
- .8 Controls and Safeties:

AIR HANDLING UNITS – PACKAGED

- .1 Unit shall be complete with self-contained low-voltage control circuit protected by a fuse on the 24-V transformer side.
- .2 Unit shall incorporate a solid state compressor protector which provides anti-cycle reset capability at the space thermostat, should any of the following standard safety devices trip and shut off compressor.
 - .1 Compressor over temperature, overcurrent.
 - .2 Loss-of-charge/low-pressure switch.
 - .3 Freeze-protection thermostat, evaporator coil.
 - .4 High-pressure switch
 - .5 Automatic reset motor thermal overload protector.
- .9 Operating Characteristics:
 - .1 Unit shall be capable of starting and running at 52°C ambient outdoor temperature, meeting maximum load criteria of ARI Standard 210/240 or 360 at ±10% voltage.
 - .2 Unit shall come complete with low ambient cooling option capable of operating down to -28°C.
- .10 Electrical:
 - .1 Unit voltage shall be 575V/3Ph/60Hz. All unit power wiring shall enter unit cabinet at a single factory-predrilled location.
- .11 Motors:
 - .1 Compressor Motors: cooled by refrigerant gas passing through motor windings, line break thermal and current overload protection.
 - .2 Evaporator-fan Motor: permanently lubricated bearings, inherent automatic-reset thermal overload protection.
 - .3 Totally-enclosed Condenser-fan Motor: permanently lubricated bearings, inherent automatic-reset thermal overload protection.
- .12 Special Features:
 - .1 Roof Curbs: formed galvanized steel, wood nailer strip, capable of supporting entire unit weight.
- .13 Electronic Thermostat shall use built-in compressor cycle delay control for cooling duty.
- .14 Acceptable Product: “Carrier” Model: 50HJ-005-5

Part 3 Execution

3.1 INSTALLATION

- .1 Provide appropriate protection apparatus.
- .2 Install units in accordance with manufacturer's instructions and as indicated.
- .3 Ensure adequate clearance for servicing and maintenance.

AIR HANDLING UNITS – PACKAGED

3.2 FANS

- .1 Provide fan sheaves required for final air balance.

END OF SECTION